

PHOTOPOLYMERIZATION

XIII MEMS FAB

B. Clean Room Photopoly. LENS

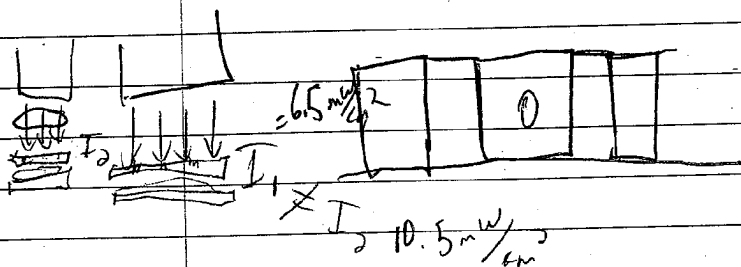
mole %	Ceraset(g)/Actual	(40%g)/Actual	ITX(g)/Actual
1.25	7 / 7.0010	0.0272 / 0.0274	0.0246 / 0.0245

METHOD

EXPOSE TIME: 26 min SPIN SPEED: 1500 rpm 15 sec

RINSE ACETONE 1000 RPM 5-10 sec

ID	SUBSTRATE	LENS	HEIGHT	OBSERVATION
Si-1	Si	No		
Si-2	Si	YES		
Si-3	Si	YES		
Si-4	Si	YES		
GRAPHITE		No		



Reads ~~13~~ 20 on dial
21 & 46.5 for
Graphite
good for both
Graphite

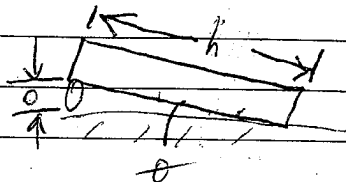
13 for on dial for Si

PHOTOPOLYMERIZATION

XIII MEMS FAB

C. DEPTH OF CURE

Glass ~~and~~ trench dimensions



$$\sin \theta = \frac{D}{h}$$

$$\theta = \sin^{-1} \left(\frac{D}{h} \right)$$

EXPOSE TIME: 20 min

(10)

D. ~~SVB~~ w/Teflon AF molds

- 1) ~~SVB~~ Etch Si w/48% HF (oxide layer)
- 2) SPIN 530 rpm (15 sec) SV8-10
- 3) Hot plate 165°C (8 min) Burst any bubbles
- 4) BAKE 20 min
- 5) EXPOSE 20 sec
- 6) Post Exposure bake 50°C hotplate 1 min
- 7) Develop 8 min

E. CASTING w/Teflon AF

TEFLON AF

- 1) SPIN for 30 sec @ 1500 rpm
- 2) Bake on hot plate 45°C for 5 min.
- 3) " " " " 145° for 5 min
- 4) " " " " 245° for 10 min - let cool
- 5) Dice & Fill
- 6) From filling,

(62)

PHOTOPOLYMERIZATION

XV THIO-ENE ADDITION

$$\frac{\text{MW Ceraset}}{\text{Funct. grp.}} = \frac{333.694}{3} = 111.23 \frac{\text{g/mol}}{\text{Funct. group}}$$

$$\frac{\text{Thiol ene}}{\text{Funct. grp.}} = \frac{488.66 \text{ g/mol}}{4} = 122.165 \frac{\text{g/mol}}{\text{Funct. group}}$$

$$\frac{111.23}{122.165} = 0.91 \frac{\text{g Ceraset}}{\text{g Thiol}}$$

$$1.51159 \text{ g Ceraset} = 0.91 \times \text{g Thiol}$$

$$1.51159 \text{ g Ceraset} = X \text{ g Thiol}$$

$$0.91$$

$$1.66109 \text{ g} = \text{Thiol} \times$$

$$\text{MDA} = 0.02138 \text{ g}$$

PEAKS

Region 1	Region 2
THIOL (2616, 2460)	(1606, 1581) C=C

Region

- ANALYSIS

Thiol - Areas with shoulder - 41%

Area without shoulder - 39%

ENE - AREA - (63%) (37% ~~but~~ conversion)

hials
still left (122)

116

PHOTOPOLYMERIZATION

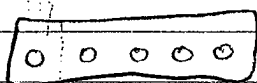
1598-155

1612 1573

FTIR - Mono Thiol ADDITION

$$\frac{\text{MW Ceraset} - 333.694}{\text{FUN. GROUP } 3} = \frac{111.23 \text{ g/mol}}{\text{FUNCTIONAL GROUP}}$$

$$\frac{\text{Mono Thiol} - 146.30}{\text{FUN. GROUP } 1} = \frac{146.30 \text{ g/mol}}{\text{FUN GROUP}}$$



$$\frac{111.23 \text{ g/mol}}{146.3 \text{ g/mol}} = \frac{0.76 \text{ g Ceraset}}{\text{g Mono Thiol}}$$

$$X \text{ g MONOTHIOI} = \frac{.05401 \text{ g Ceraset}}{0.76} = .071$$

$$X_g = .07236$$

2 wt% Benzophenone

$$\frac{X_g \text{ BP}}{X_g \text{ BP} + X_g \text{ Sol}} = 2\%$$

$$X_g \text{ BP} + X_g \text{ Sol}$$

$$X_g \text{ BP} = .02(X_g \text{ BP} + X_g \text{ Sol})$$

$$X_g \text{ BP} + 0.02 X_g \text{ BP} = .02 X_g \text{ Sol}$$

$$X_g \text{ BP} = \frac{.02 \cdot X_g \text{ Sol}}{1.02} = .00248$$

$$X_g \text{ BP} = .00202$$

(125)

PHOTOPOLYMERIZATION

C=C PEAK

1608.37 1583.3

Thiol PEAK

2597.7 2514.76

SERIES SETUP

Cervet

Mon Thiol

426

PHOTOPOLYMERIZATION

FTIR MONO-THIOL ADDITION

$$X_g \text{ Ceraset} = .05831$$

$$Y_g \text{ Monothiol} = \frac{X_g \text{ Ceraset}}{0.76} = .0767g$$

$$Y_g (\text{ACTUAL}) \text{ MONOTHIOLE} = .07678g \quad Z_{\text{SOLUTION}} = 0.12978$$

(Benzophenone)

$$X_g \text{ BP} = \frac{0.02 \cdot Z_{\text{solution}}}{1.02} = .0025g$$

$$X_g \text{ BP} = .00279$$

Pure BP-monothiol 1.5px

THIOL (2589, 2527) (2589, 2527)

C=C (1609, 1585) (1609, 1564)

OBSERVATIONS: SPECTRA UNCLEAR

INCREASE THIOL By 3

Decrease BP wt% to 0.5

- ANALYSIS

More peak shoulders

66% CONVERSION

% CONVERSION

C=C

Thiol

Get a shot
of this

C

Photopolymerization

FTIR Monothiol Addition

$$X_g \text{ Caracet} = 0.05268g$$

$$Y_g \text{ Monothiol} = \frac{0.05268g}{0.76 \times 7} = 0.0693g \times 3 = 0.2079g$$

$$Y_g \text{ Monothiol (ACTUAL)} = 0.20881g$$

$$Z_g \text{ Solution} = 0.26149$$

$$X_g \text{ BP} = \frac{0.005 \cdot Z_g \text{ solution}}{1.005} = 0.00130g$$

$$X_g \text{ BP (ACTUAL)} = 0.00180g$$

$$\text{Thiol} (2592.9, 2500.3) \quad (2593.8, 2501.3)$$

$$\text{C=C} (1610.3, 1584.26) \quad (1610.3, 1584.26)$$

ANALYSIS

C=C 82% CONVERSION ~ 100% All
CONVERSION 31% THIOL PEAK 6/9 Thiols
Reacted